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LAYING AND REPAIRING A 12-INCH SUBAQUEOUS MAIN TO NORTH BROTHER ISLAND, NEW YORK¹

BY PATRICK QUILTY²

The City of New York, acting through its Department of Water Supply, Gas and Electricity, awarded a contract for "furnishing, delivering and laying a 12-inch water main across the East River from East 140th Street to North Brother Island, and hauling and laying water mains in East 140th Street and on North Brother Island, Borough of The Bronx," on May 17, 1915. The time allowed under this contract for the completion of the work was 100 working days, and work was commenced on June 7, 1915.

The hauling and laying portion of this contract was practically completed before the end of September, 1915, and consisted of hauling and laying pipes, valves and hydrants furnished by the Department. The flexible jointed pipe furnished by the contractor was laid by him across the East River, including the shore connections, between September 22 and November 16, 1915. The distance across is approximately 1700 feet, figure 1, and the actual length of the pipe line between valves is 1843 feet. The valve on the Bronx side is 83 feet from the edge of the dock in the New York Central Railroad yard through which this pipe is laid. The valve on North Brother Island is about 60 feet from the sea wall. The type of flexible joint used is shown in figure 2; the groove for facilitating the pouring of the lead was first used in the repair work described later.

In prosecuting this work, when about 200 feet from the Bronx shore, the end of the pipe line became disconnected from the lighter and went to the bottom of the river. In recovering and raising the pipe, the hubs of two lengths were broken and it was necessary to remove ten lengths in order to get out these two. In the ten days from October 14 to October 23, inclusive, 113 lengths of pipe were laid. Each length is 12 feet and weighs approximately 2400 pounds.

¹ Read before the New York Section, October 22, 1919. Discussion of this paper is requested and should be sent to the Editor.

² Assistant Engineer, Department of Water Supply, Gas and Electricity, New York, N. Y.

The force consisted of 1 foreman, 4 sailors, 1 calker, 1 leadman, 1 engineman and 1 night watchman. Besides the lighter, a tug and a row boat were in use. The depth of the river at this location is 80 to 90 feet.

The contractor was not successful in obtaining the test called for by the specifications. The following extract is taken from section 83 of the specifications:

. . . . After the flexible jointed pipe is in place it shall be subjected to a water pressure of 70 lbs. per square inch. Under this pressure the leakage from the flexible jointed pipe shall not exceed the rate of fifteen (15) gallons for 24 hours per linear foot of joint distribution over the entire section, the

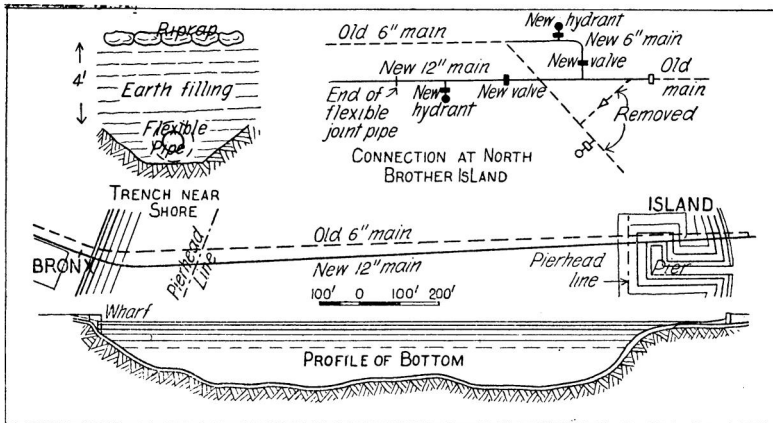


FIG. 1. SUBAQUEOUS MAIN TO NORTH BROTHER ISLAND

length of each joint being figured on the nominal interior diameter of the pipe After the pipe has been filled with water, the pressure of 70 lbs. per square inch shall be applied and maintained for 30 minutes, during which time the amount of water forced into the pipe shall be determined. This measurement shall serve as the basis to compute the leakage for 24 hours.

If the leakage is at a greater rate than that specified herein, the contractor shall recalk and, if necessary, remake the joints until the leakage shall not exceed the rate specified; if after recalking and examining the entire line, the leakage is in excess of that allowed, the contractor may, with the approval of the engineer, adopt some other method to make the joints watertight and bring the leakage within the prescribed limits.

The allowable leakage on this line, which contains 157 12-inch flexible joints, 9 12-inch ordinary joints and 7 6-inch ordinary joints between valves, is at the rate of 166.5 gallons in 30 minutes, or 5.5

gallons per minute. The best that was obtained by the contractor during 1916 showed a leakage of approximately three times this allowance.

In May, 1916, the contractor wrote that he would be ready to test the line within a short period. The diver reported about this time that one of the pipes had a split hub. The location of this joint was given as being 75 feet from shore and in 65 to 70 feet of water. The contractor submitted a drawing of a split sleeve which he proposed to place around the split hub, to make the joint water-

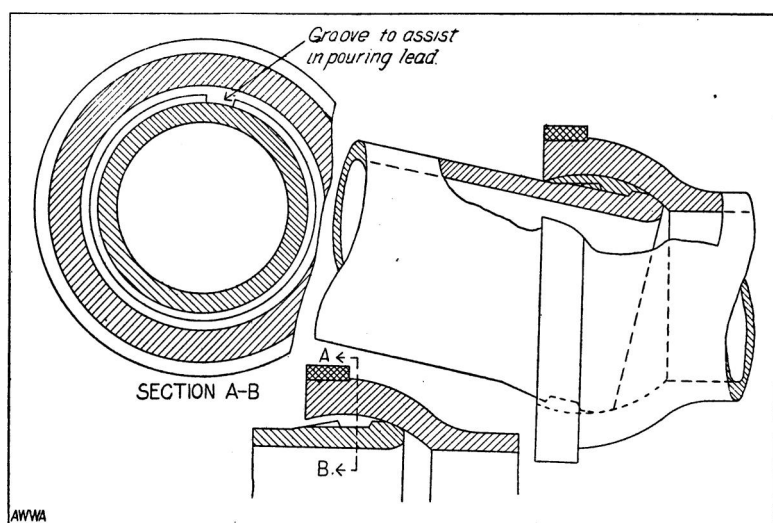


FIG. 2. FLEXIBLE JOINT FOR NORTH BROTHER ISLAND MAIN

tight. On February 9, 1917, the diver reported that the sleeve was in position, bolted, and calked. A test on May 7, 1917, showed a leakage of 15.5 gallons per minute under 70 pounds pressure against the allowable leakage of 5.5 gallons per minute. An air compressor showed a large leak at apparently the location of the split hub, but the diver reported that the sleeved joint was water-tight and that this leak was a new leak about 20 feet beyond the sleeve. He also stated that at the new leak the pipe had taken its maximum deflection, or, as he expressed it, was "iron to iron." Neither one of these statements was borne out by the facts. The diver reported that each time he calked lead into this "iron to iron" joint, the lead blew out again when the pressure was turned on, and he said he

could not make this joint watertight. The contractor claimed that this was a new development for which he was not responsible. It did not appear that the rusting of the joints aided materially in preventing leakage under pressure.

The contract was declared abandoned on June 20, 1917.

The main was placed in service and has been in service up to the present time, except when the line was shut down for testing or repairs. Under an order from the Department of Water Supply, Gas and Electricity, a firm of divers made an examination of the line in July, 1918, and reported that there were eight leaks. One joint approximately 115 feet from the dock was reported to be leaking badly all around.

A contract was let on July 3, 1919, for a lump sum, to complete the work of the abandoned contract. The new contractor attempted to repair the line by use of diver and diver's outfit only, viz.: launch and air pump, but was unsuccessful, and after a month's trial abandoned that method. A floating hoisting derrick was then employed. The line was cut at the Bronx shore, the joints burned out by acetylene burner and the pipe removed for a distance of 130 feet from the edge of the dock. The following lengths of pipe were removed: one 9-foot length, one double-hub piece 2 feet long, four 6-foot lengths and eight 12-foot lengths, a total of 130 feet.

The sixth 12-foot length, 107 feet from shore, was found to have the hub split in three places, the cracks extending from the face of the hub entirely through the length of the hub, figure 3. Lead had been calked into these openings in the face of the hub, but no split sleeve was found. One half of a wrought iron band, 2 inches wide by $\frac{1}{2}$ inch thick, was found tied around the pipe with a piece of rope. The other two pipes removed beyond this did not show any defects, but were removed on account of the previous diver's report that a new leak had developed 20 feet beyond the sleeve. Three more lengths of pipe were lifted out of the water for examination but as no defects appeared they were not burned out.

The pipe was then lashed horizontally to the lighter, the double hub piece and one length of pipe being laid and joints run horizontally. The use of the double hub piece reversed the joints towards the Bronx shore, otherwise it would have been extremely difficult to reconnect the line. The last pipe laid was then held vertically by the derrick and the others allowed to drop slowly into the river. The remainder of the line from here to the shore was laid in the ordi-

nary way. The end of the line was then lifted horizontally and pushed through the cribwork of the dock to be made up to the remaining flexible pipes which were left in the ground. This joint was made horizontally, it being completely exposed at low tide. It might be mentioned here that there are three New York Central Railroad freight tracks, side by side, under which the flexible pipe was laid through the cribwork of the dock. The easterly rail of one of the tracks is within 4 feet of the edge of the dock. The distance

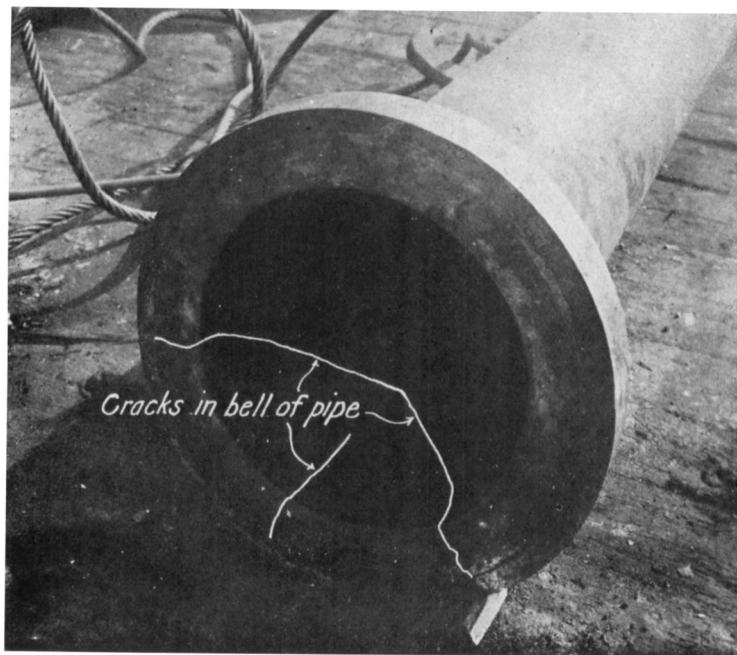


FIG. 3. CRACKS IN PIPE 107 FEET FROM BRONX SHORE

from the edge of the dock to the 12-inch valve is 83 feet, and all except 3 or 4 feet is flexible-jointed pipe.

An interesting occurrence took place here. When the contractor was ready to lay his last two pipes, he measured the distance from the end of the last pipe laid and held by the derrick to the end left in the ground, and it appeared that more pipe would be placed in the line than was there originally by approximately 9 feet. When the joints were run, however, and the main outside the dock lowered to the bottom from the derrick, two joints on shore, 18 and 27 feet

from the dock, buckled. These joints were burned out, the extra length of pipe removed, and the remaining end of the pipe moved inland of its own accord to within about a foot of its original position.

The remaining pipe, flexible and ordinary, was taken out and relaid to the 12-inch valve. It was expected that, owing to the frequent raising and lowering of the end of the main near the dock, and the consequent flexing of the joints up and down, the lead would have been compressed in the joint and leakage would occur. An air compressor showed eight leaks close to the dock. Up to this writing a diver (not the one who put on the phantom sleeve), has made seven of these joints watertight. Other leaks appear 150 to 200 feet from the dock. The contract is not yet completed.

Outside of the difficulty at this place, the remainder of the line is in good condition, as evidenced by the fact that it has been emptied of water repeatedly, filled with compressed air to 30 or 40 pounds pressure and a few times to much higher pressures, then emptied of compressed air and filled with water again. Also, the pressure on North Brother Island does not vary materially from the pressure at the Bronx shore, which is about 50 pounds per square inch.

It is evident that a flexible jointed pipe line, properly constructed, is well suited for the purpose of a water supply under conditions like those shown, but it is also evident that a flexible pipe line is not meant to be lifted up and down repeatedly, as this compresses the lead in one position of the joint and in the reverse position this compressed lead does not fill the joint and allows leakage.

The number of hours that a diver can work at a location like this where the tide is strong and sweeping, varies greatly. In winter, with ice in the river, about one-half an hour at each tide is all that can be expected. Divers have at times stayed submerged only 15 minutes at each tide. In good weather, and when the river is calm, two hours at each tide can be utilized. No great difficulty was experienced in keeping the floating derrick steady.

It was found advantageous to cut a groove in the spigot end of the pipe, parallel to its axis, to permit the lead to flow quickly to the circumferential groove around the spigot end. This groove may be rectangular or U-shaped and about $1\frac{1}{2}$ inches wide, as shown in figure 2.